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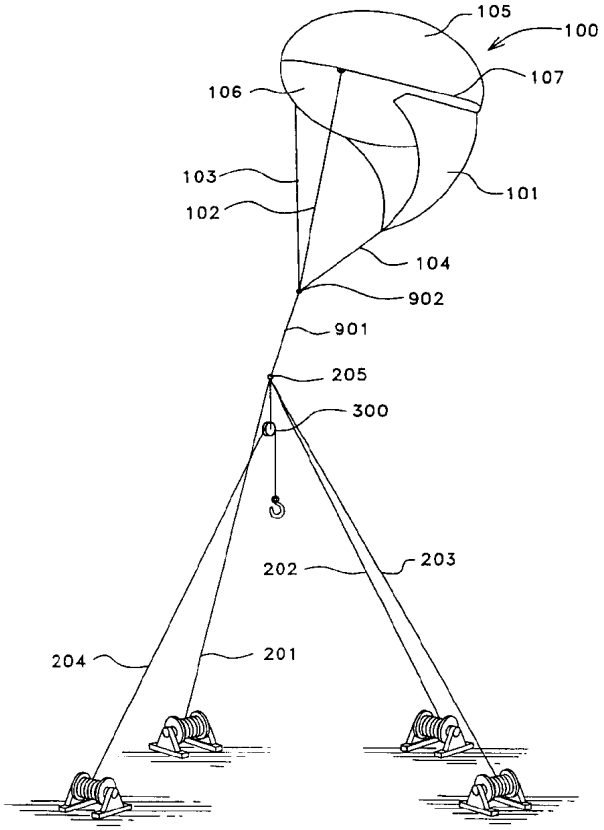
(54) Title: BALLOON LIFTING SYSTEM

(57) Abstract

The invention comprises a balloon system for lifting loads. A balloon (100) is attached to the apex (205) of a series of guy wires (201, 202, 203). The guy wires are attached to moveable or stationary anchor points, such as the ground or heavy vehicles. A pulley (300) is suspended from the peak or apex of the guy wires. A winch line (204) is routed from a lift winch on the ground over the pulley to a hook. The load is attached to the hook for lifting. The balloon comprises an airdam (101). The airdam provides lift and control in windy conditions. The position of the balloon can be controlled by moving the locations of the guy lines (201, 202, 203) independently or in unison, or by changing the length of each or all of the guy lines independently or in unison. The system also provides a platform for lifting various loads to a position above the ground.



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TITLE

Balloon Lifting System

CROSS-REFERENCE TO RELATED APPLICATION

This application is a non-provisional application claiming the benefits of provisional application no. 60/132,621 filed May 5, 1999.

FIELD OF INVENTION

The present invention relates to the field of lighter than air devices designed to lift loads with a balloon and winch system.

BACKGROUND OF THE INVENTION

Balloon lift systems are known in the art. They have enjoyed use in various industries, including search and rescue and timber or logging. The systems generally comprise a lighter than air lifting device, i.e., balloon, connected to a tether system that allows control of the altitude and spatial location of the balloon. The system allows a user to lift a load vertically. If lateral movement of the load is required, a cross cable system is used that allows the operator to laterally move the lift cable. This moves the load and balloon. The system requires the lateral movement cables to be placed over the load and over the location where the load is to be placed. They offer limited flexibility as far as changing the location of placement of the load once the load has been lifted. The lateral cable system is generally cumbersome, and moving it is dangerous and labor intensive. Further, balloon lift systems are unstable in windy conditions, making them

unattractive for lifting work where winds are encountered. By extension, wind sensitive systems cannot offer added lift once a wind starts blowing.

Another area where balloon lift systems have been used is for equipment platforms for aerial photography, radar, light sources, weather monitoring stations and similar uses. There is a need for simple to operate, stable lift platform for many of these devises. Prior art balloon lift systems have often been unsuited to these uses because of the instability in windy conditions noted above.

The present invention solves these problems by creating a balloon which is stable in winds up to 90 MPH or more. The present invention attaches an airdam stabilizer to the balloon, allowing it to be used in many conditions and for many uses that prior art balloon systems were not suited for.

SUMMARY OF THE INVENTION

The main aspect of the present invention is to provide a balloon lifting system having a balloon tethered to an anchor point.

Another aspect of the present invention is to provide a balloon lifting system having a winch for lifting a load.

Another aspect of the present invention is to provide a balloon lifting system having a plurality of moveable guy lines.

Another aspect of the present invention is to provide a balloon lifting system having a balloon with an airdam for providing lift and

stability.

Another aspect of the present invention is to provide a balloon lifting system that is stable in extremely windy conditions.

Another aspect of the present invention is to provide a balloon lifting system whereby lift increases with increased wind speeds.

Another aspect of the present invention is to provide a balloon lifting system whereby the balloon will lift a load in windy conditions when filled with lighter-than-air gas.

Another aspect of the present invention is to provide a balloon lifting system whereby a load is lifted to a position above the ground and held there.

Another aspect of the present invention is to provide a balloon lifting system whereby a lifting platform for various uses is provided.

Other aspects of this present invention will appear from the following description and appended claims, reference being made to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

The invention comprises a system for lifting loads. A balloon is attached to a series of guy wires. The guy wires are attached to moveable or immovable anchor points, such as the ground or heavy vehicles. A pulley is suspended from the peak or apex of the guy wires. The apex is located below the balloon. A winch line is routed from a lift winch on the ground over the pulley to a hook or any other means of attaching a load to the lift line, known in the art. The load is attached

to the hook for lifting. The balloon further comprises an airdam. The airdam provides lift in windy conditions, up to 90 MPH. Moving the locations of the guy line anchors independently or in unison can control the position of the balloon. The guy line anchors are moved to position the apex over a load. Once the load is lifted, the guy line anchors can be moved to relocate the apex. Once the apex is moved, the load can be lowered.

The present invention can also be used as an aerial equipment platform for a wide variety of uses which require an easy to use, stable platform.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a bottom perspective view of the present invention.

FIG. 2 is a bottom plan view of the balloon of FIG. 1.

FIG. 3 is a bottom perspective view of the balloon of FIG. 1.

FIG. 4 is a table showing test results for the balloon.

FIG. 5 is a schematic of the invention showing the angle of attack.

FIG. 6 is a bottom perspective view of the invention lifting a load.

FIG. 7 is a top plan view of an alternative embodiment of the rigging system.

FIG. 8 is a perspective view of the airdam before it is attached to the balloon.

FIG. 9 is a bottom perspective view of an

alternate embodiment of the guy line attachment

FIG. 10 is a bottom perspective view of the present invention used as an aerial equipment platform.

FIG. 11 is a bottom perspective view of the present invention in still air showing the nose down configuration of the balloon.

Before explaining the disclosed embodiment of the present invention in detail, it is to be understood that the invention is not limited in its application to the details of the particular arrangement shown, since the invention is capable of other embodiments. Also, the terminology used herein is for the purpose of description and not of limitation.

DETAILED DESCRIPTION OF THE DRAWINGS

FIG. 1 depicts a top perspective view of the present invention. Balloon 100 is anchored to the ground or other surface by guy lines 201, 202 and 203. Balloon 100 is known in the art and comprises any material available that provides tear resistance when subjected to loads, such as when the balloon is lifting a load. Although the preferred embodiment has shown with three guy lines, any number greater than two will also work as well.

Balloon 100 comprises an upper portion 105 and a lower portion 106. The balloon 100 can be made a variety of shapes, such as an oblong shape similar to a parasail. A circular shape is the preferred embodiment because it requires the least amount of gas to fill. Shrouds 102 and 103 are attached to apex 205 and to tether points on a midline 107 on balloon 100. Airdam 101 is attached to the lower portion 106 and to shroud 104 at tether

point 309. Airdam 101 provides lift and it allows the balloon 100 to be steered into a prevailing wind. The airdam 101 provides lift for the system when the wind is blowing. Airdam 101 has a curvilinear shape that enhances the aerodynamic behavior of the airdam and its usefulness in providing lift as well as control of the balloon.

The lifting capacity and the stability of the system is enhanced by use of the airdam 101 on balloon 100. A wind incident on the airdam 101 and balloon 100 will cause the airdam 101 to generate lift, thereby increasing the system's ability to lift a load. The system may be used in winds over 90 mph. The airdam 101 is fabricated of porous material, such as sheer organza nylon by Rosebar Textile of, California. If a non-porous material is used to make the airdam 101 the stability of the system is greatly decreased.

FIG. 8 shows the airdam 101 before it is attached to the balloon 100. Airdam 101 has a height d_1 and a width at the longest point of d_3. The length of d_3 is preferably less than ½ the circumference of the balloon 100. The airdam 101 is attached to balloon 100 on the lower portion 106 along attachment edges 801, 802 and 803. The edges 802 and 803 are at an acute angle χ measured from line A. In the preferred embodiment angle χ is 40°.

The airdam 101 can be attached to the balloon 100 with adhesives or by sewing. The airdam 101 must be attached below the midline 107 on the lower portion 106. If the airdam 101 is attached at the midline 107 the balloon is unstable and tends to oscillate in the wind.

FIG. 2 is a bottom plan view of the balloon. Airdam 101 is attached to the lower portion 106.

Shroud 102 is attached to balloon 100 at tether point 115. Shroud 103 is attached to balloon 100 at tether point 116. Tether points 115 and 116 are located at points at an angle of approximately 45° to a centerline C. Tether points 115 and 116 further comprise any known grommet arrangement used to strengthen a line connection point.

One example of the balloon 100 was made using a 20ft diameter round balloon from Giant Advertising, Inc. of Huntington Beach, Calif. The balloon 100 was made from polyurethane coated nylon. The airdam 101 was made from nylon organza. D_1 equaled 7ft; and d_2 equaled 27 ft on the airdam 101. Sides 802 and 803 were 2 ft each. The airdam was attached about 2 ft down from the midline 107 with transfer tape, Killer Red™ made by Bron Tape Co. of Denver, CO.

As shown in FIG. 1, guy lines 201, 202, and 203 are each attached to a mounting or anchor point, such as the ground or a heavy vehicle 401, 402, 403. Pulley 300 is attached to the apex 205. Apex 205 is a common connection point of guy lines 201, 202, and 203 and is located below the balloon. Winch line 204 is connected to a load L and used to lift a load L. Winch line 204 is routed from the lift winch 301, over pulley 300 to a load L. Balloon 100 is attached to apex 205 with the shrouds 102, 103 and 104 as described above.

In an alternate embodiment, shown in FIG. 9 a secondary tether 901 separates the connection point of the guy wires 201, 202 and 203, the apex 205, from a common connection point 902 of the shrouds 102, 103 and 104. That is, a single tether 901 is used to extend the balloon above the apex 205 by a predetermined number of feet. In effect, the shrouds 102, 103 and 104

are connected to a common point 902. The common point 902 is then connected by a length of tether 903, to the apex 205 below the common connection point 902 for the shrouds. This arrangement can enhance the stability of the system in high winds by elevating the balloon 100 further above the apex 205.

In operation, balloon 100 is inflated with helium, or any other `lighter-than-air' gas. The diameter of the balloon may range from 10 feet to 100 feet or more, depending upon the necessary lifting requirements. Guy lines 201, 202 and 203 are then deployed in such a manner so as to allow balloon 100 to rise to a predetermined elevation, over a particular location. The elevation may range up to several thousand feet above the ground, only limited by the length of the guy lines 201, 202 and 203. The location of the balloon 100 is controlled by the location of the anchor 401, 402 and 403 of each guy line, and thereby each guy line 201, 202 and 203. Movement of a particular guy line anchor 401, 402, or 403 will result in a corresponding movement of the balloon 100 and apex 205.

In an alternate embodiment shown in FIG. 5, the guy lines 201, 202, and 203 are attached to immovable anchors 501; and then the lengths of the guy lines 201, 202 and 203 may be adjusted to properly position the location of the balloon 100 and apex 205. Selectively lengthening or shortening each or all of the guy lines 201, 202, and 203 will move the location of the apex 204 and the balloon 100, due to the triangular arrangement of the guy lines. For example, this is accomplished by attaching each guy line 201, 202 and 203 to a winch 502. The length of each guy line 201, 202 and 203 is then adjusted by reeling or unreeling the given guy line on its winch 502. Each winch 502 described herein is controlled by an

operator or by a series of operators working in unison. This system will work as well with any number of guy lines, ranging from two on up.

To lift a load off a rooftop, as shown in FIG. 1, once deployed, guy line anchor 401 is moved in order to cause the apex 205 to move over the roof. The geometry of the situation will dictate the length and direction of movement of the guy line anchor 401, or a plurality of guy line anchors 401, 402 and 403. Lift winch 301 is then operated to lower the hook 305 to the roof. Once the load L is attached, winch line 204 is reeled in, thereby raising load L. Guy line anchor 401 is then moved back in the direction it came from in order to move the apex 205 from over the roof. Once load L is over the area where it is to be placed, winch line 204 is unreeled and the load L is lowered. Each of these movements is made in consideration of and with respect to the prevailing winds.

If very heavy loads are to be lifted with the balloon 100 it can be necessary to use an alternate attachment or rigging system 700, as shown in FIG. 7, because a heavy load could cause the balloon fabric to tear. A center ring 701 has three rigging lines 702, 703 or 704 attached to it. The center ring 701 is attached to the balloon 100 at top midpoint C, either by sewing or adhesives. The lines 702, 703 and 704 correspond to shrouds 102, 103 and 104 and are spaced identically on the balloon 100. Extra stress lines 705 can be added between line 702, 703 and 704 to further distribute the weight over the top surface 105 of the balloon 100. Line 704 is further attached to the attachment point 306 on the airdam 101 to hold the airdam 101 taunt. The lines 702, 703 and 704 can be run through rings 706 attached to the balloon 100 to further hold the lines 702, 703 and

704 in position.

The system is also used to provide a platform for lifting a load from the ground to a position above the ground as shown in FIG. 10. The balloon 100 is rigged with the shrouds 102, 103 and 104 as described above. The apex 205 is then attached to a single tether or winch line 1001. Load lines 1003, 1004 and 1005 are attached to the lower portion 106 at connection points 1006. A video camera 1002 is attached to the load lines 1003, 1004 and 1005. The video camera 1002 is then raised to a position above the ground where it can be used to survey the surrounding area. Other loads may include radar, radar reflectors, signal transmitters, light sources, advertising banners, artillery targets, fire hoses, water buckets, guns, observation baskets for personnel, or any other load suitable for lifting by the system. The invention will lift each load in high prevailing winds and remain stable so that the equipment can function.

The lifting capacity of the system is as follows, offered by way of example and not of limitation:

Balloon Diameter/Ft.	Balloon Volume/Ft.^{3}	Balloon Lift Force/lbs.
10	189.1	11.81
20	1513.1	94.56
30	5106.6	391.16
50	23,641.7	1477.60
75	79790.7	4986.9
100	189,133.6	11,820.85

The entire system can be moved to allow placement of the apex 205 in any desired location. This is accomplished by moving all guy line anchors 401, 402, 403 in a coordinated manner, individually or in unison,

or by changing the length of each or all of the guy lines independently, or in unison.

The balloon 100 will lift a load L in winds in excess of 10 MPH even if it is filled with gas that is not lighter-than-air, for example, an atmospheric mix of gasses. The airdam 101 provides lift for the balloon 100 in windy conditions in the absence of any lift being provided by the gas filling the balloon 100 itself.

The lifting characteristics of the invention are described in terms of the angle of attack of the balloon. FIG. 5 is a schematic of the invention showing the angle of attack. The airdam 101 allows the balloon to lift loads in a stable manner in winds up to 90 MPH. When the wind blows from direction W toward the invention, the tether 650 will assume a characteristic angle α. In the preferred embodiment of the invention α =58°.

The shrouds 102, 103 and 104 on the balloon 100 are arranged such that the balloon 100 assumes a ``nose-down'' attitude in still air, as shown in FIG. 11. The magnitude of the nose-down condition, or attack angle A, is measured in terms of angle β, which is measured from a centerline of the balloon as compared to its relationship to a line normal to the tether centerline, as shown in FIG. 5. A negative β is generally required to achieve the proper stable flight attitude. The range of A is from 0° to -10°. The best mode of the invention is to have A = -4°. The attack angle A is calculated by the equation:

$$A = 90° - (\alpha + \beta)$$

FIG. 3 is a bottom elevation view of the balloon. Balloon 100 comprises airdam 101.

Airdam 101 is attached to the lower portion 106 of the balloon. Shrouds 102, 103 are attached to the lower portion 106, and shroud 104 attached to airdam 101. The shrouds 102, 103 and 104 are in turn attached to apex 205. The apex is attached to a single tether line 303. The single tether line 303 is used whenever the balloon 100 is used for lifting a load to a set height, such as holding a camera aloft as shown in FIG. 10, and not moving the load from one point to another, such as lifting a load off a building as shown in FIG. 1.

When the airdam 101 is mounted on the balloon 100 and the balloon is flown the airdam 100 forms a left wall LW generally parallel to a central axis CX of the balloon 100, wherein the left wall LW has an axis LX. The left wall LW is curved facing outbound from central axis CX. It joins a symmetrically shaped right wall RW which has an axis RX. The right wall is also curved convex facing outboard from the central axis CX. The left and right walls join at the rear of the balloon forming a rear joint RJ, thereby creating a pocket CP. The left and right walls also depend symmetrically downward to form a tail section T which has a triangular cross section, ending with the attachment point 306. The fabric of the airdam 101 often stretches in strong wind, increasing d_1 of the airdam 101.

When in a wind W, airdam 101 causes the front F of the balloon to be directed into the prevailing wind. Airdam 101 has a concave pocket CP to contain and control an impinging airflow. Airdam 101 stabilizes the balloon 100 so that it will not oscillate from side to side in varying wind conditions. In the event of a shift in wind direction, the weather-vane behavior of the balloon 100 causes it to simply assume a stable, down-wind position. The balloon 100 automatically adjusts

itself to a position down-wind of the prevailing wind direction via the drag of the concave packet CP.

FIGS. 4a and 4b is a table showing test results for the balloon. FIG. 4a depicts the drag force and FIG. 4b lift force of the balloon for various wind speeds, ranging from 10 mph to 90 mph. The table is for balloon diameters of 10 feet to 100 feet.

Although described herein in terms of lifting a load from a roof, the system can be used to lift any appropriately sized load from any first elevation to any second elevation, or, from any first location to any second location at the same elevation.

Although the present invention has been described with reference to preferred embodiments, numerous modifications and variations can be made and still the result will come within the scope of the invention. No limitation with respect to the specific embodiments disclosed herein is intended or should be inferred.

I CLAIM:

1. A balloon suitable for lifting a load, said balloon comprising:

an upper and a lower portion and a central axis;

said lower portion having an airdam;

said airdam having a left and a right wall, each depending down from the balloon, wherein said left and right walls are symmetrical;

said left and right walls further comprising a rear joint, thereby forming a forward facing pocket;

said left and right walls further comprising a tail section; and

a load attachment system.

2. The balloon of claim 1, wherein said load attachment system further comprises:

one or more attachment points on said balloon;

one of more attachment lines attached to the attachment points; and

a load attached to said attachment lines.

3. The balloon of claim 2, wherein the balloon has a generally circular circumference.

4. The balloon of claim 2, wherein the balloon is filled with gas.

5. The balloon of claim 4, wherein the balloon is filled with lighter-than-air gas.

6. The balloon of claim 2 further comprising:

two or more rigging attachment points on said balloon and a rigging attachment point on the tail section of the airdam;

rigging lines attached to the rigging attachment points, said rigging lines meeting at an apex point a given distance bellow the balloon; and

at least one tether line attached to the apex.

7. The balloon of claim 6, wherein the tether line is attached to a winch.

8. The balloon of claim 1, wherein said load attachment system further comprises:

an attachment harness shaped to encompass the upper portion of the balloon, the attachment harness being attached to the top portion of the balloon;

two rigging lines attached to the attachment harness;

a third rigging line being attached to the attachment harness and further being attached to the tail of the airdam;

the rigging lines meeting at an apex a given distance bellow the balloon.

9. A balloon lifting system comprising:

a balloon having an upper surface, a lower surface and a midline;

an airdam having a generally triangular shape attached to the lower surface along an

attachment edge;

said airdam further comprising an attachment point opposite said attachment edge;

two rigging lines attached to said balloon along said midline and a third rigging line attached to said attachment point, said three rigging lines further attaching to an apex;

a load attached to said apex; and

at least one tether line attached to said apex.

10. The balloon lifting system of claim 9, wherein the balloon has a generally circular circumference.

11. The balloon lifting system of claim 9, wherein the balloon is filled with gas.

12. The balloon lifting system of claim 9, wherein the balloon is filled with lighter-than-air gas.

13. A balloon suitable for lifting a load, said balloon comprising:

an upper and a lower portion and a central axis;

said lower portion having an airdam;

said airdam having a left and a right wall, each depending down from the balloon, wherein said left and right walls are symmetrical;

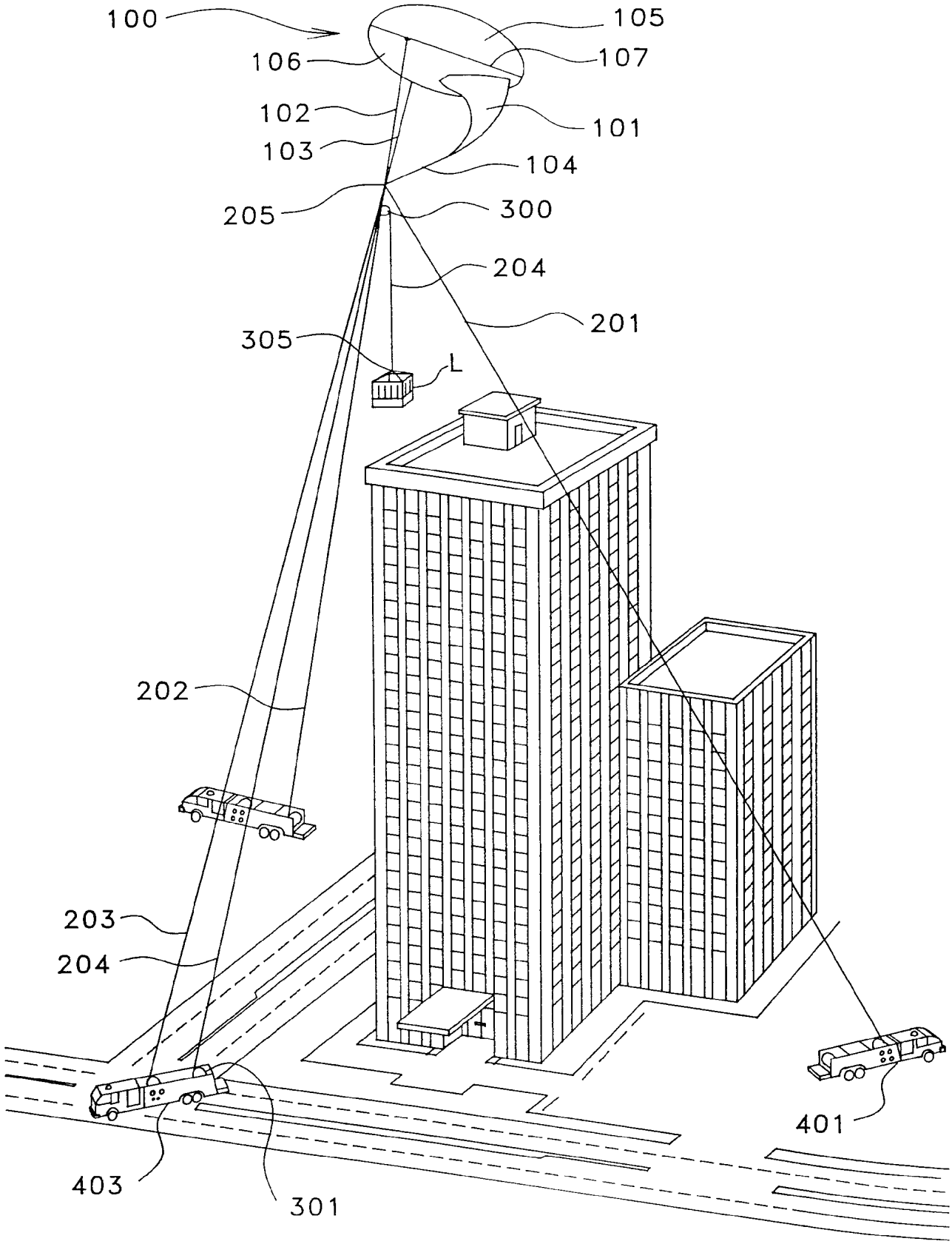
said left and right walls further comprising a rear joint, thereby forming a forward facing pocket;

said left and right walls forming a tail section; and

said balloon having a diameter of at least eight feet.

14. The balloon of claim 13, wherein said airdam further comprises a concave facing forward curvature along a rear surface that provides a lift.

15. The balloon of claim 14 further comprising a load attachment system.


100
105
106
107
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301

FIG. 1

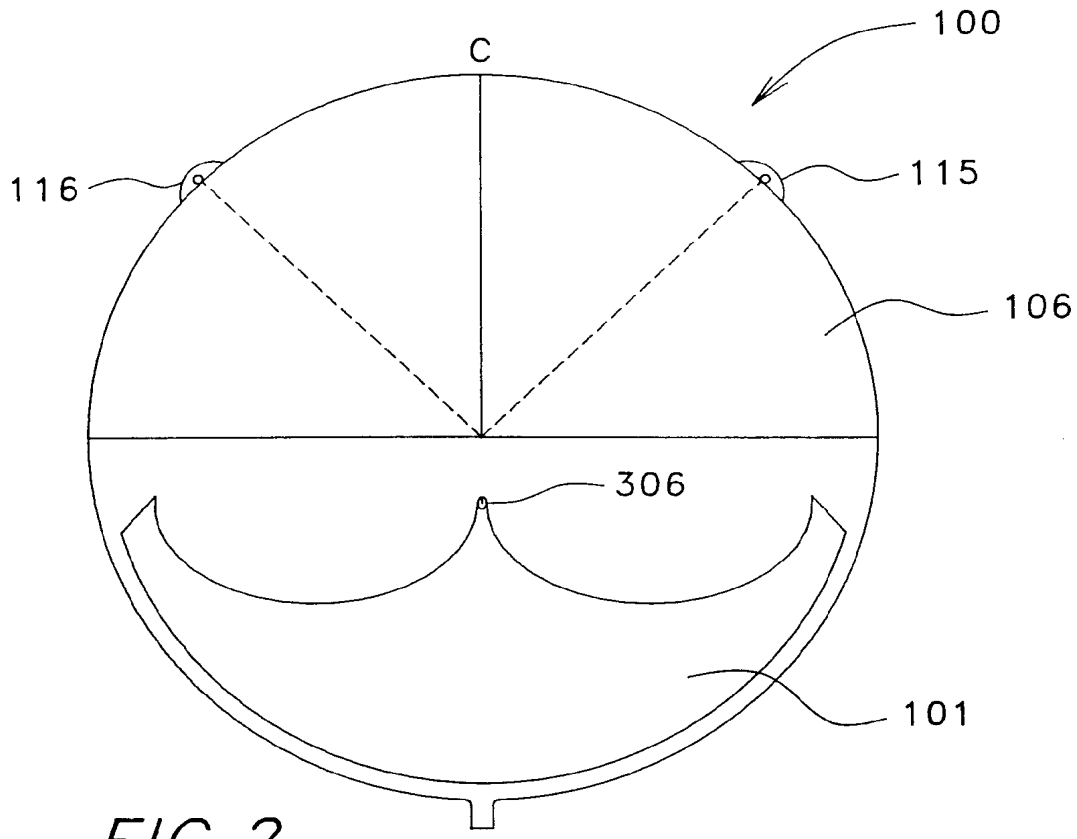

FIG. 2

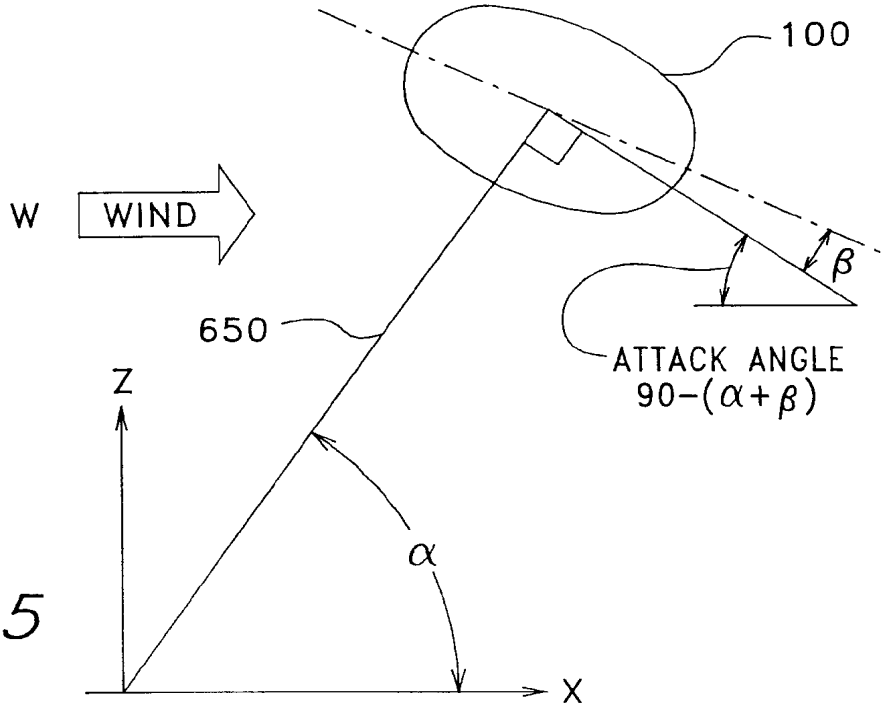

FIG. 5

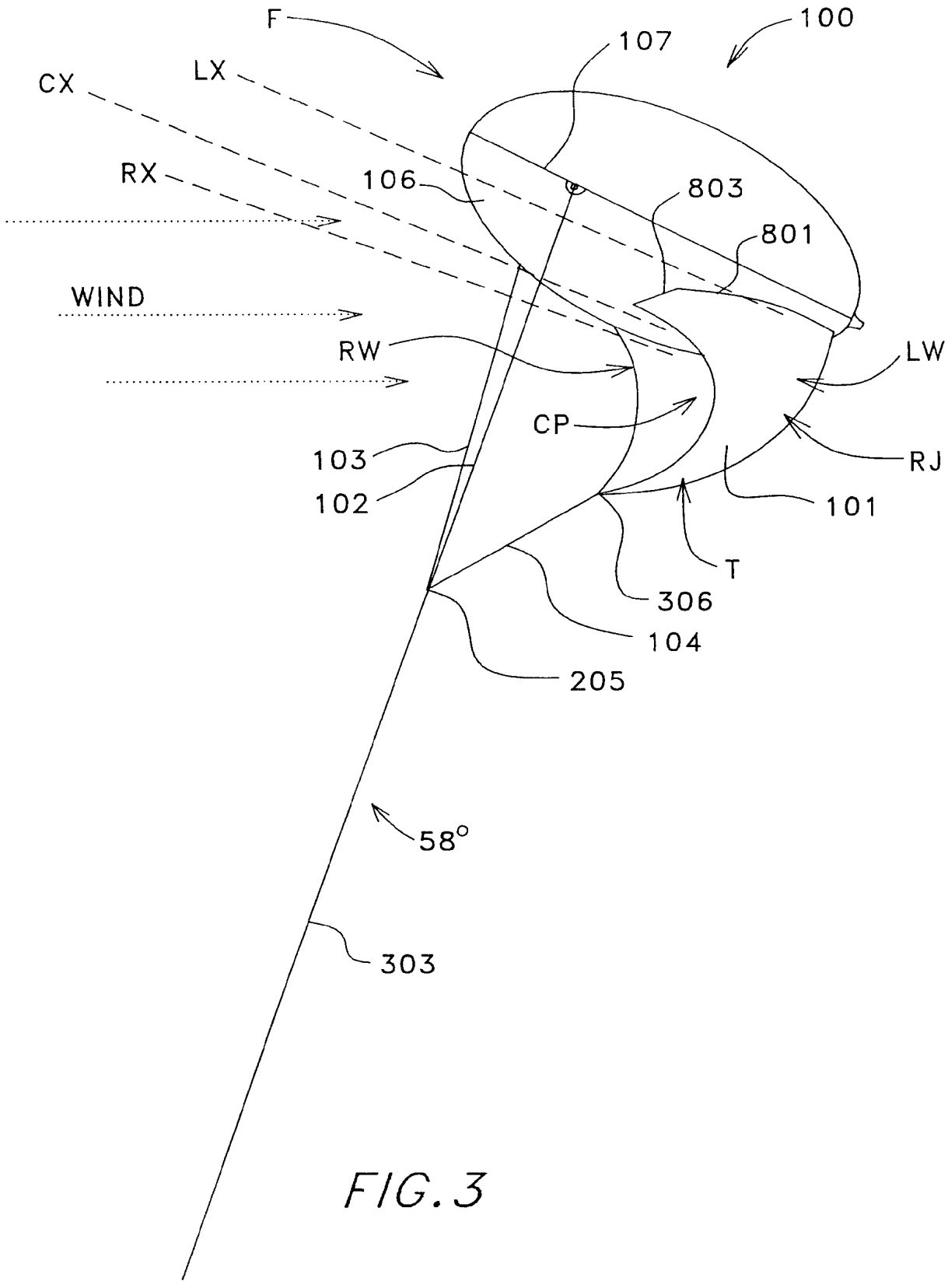
F
100
107
LX
CX
RX
106
803
801
WIND
RW
LW
CP
103
RJ
102
101
T
306
104
205
58°
303

FIG. 3

I. DRAG FORCE (LB.)

WIND SPEED	SIZE(DIAMETER OF THE BALLOON BEFORE INFLATION, FT.)					
	10	20	30	50	75	100
	ESTIMATED VOLUME CREATED AFTER INFLATION (CU. FT.)					
	189.1	1513.1	5106.6	23641.7	79790.7	189133.6
	ESTIMATED CROSS SECTION AREA AFTER INFLATION (SQ. FT.)					
	49.7	199.0	447.7	1243.7	2798.4	4975.0
10	7.0	28.1	63.1	175.4	394.6	701.5
15	15.8	63.1	142.0	394.6	887.8	1578.3
20	28.0	112.2	252.5	701.4	1578.3	2805.9
25	43.8	175.4	394.5	1096.0	2466.1	4384.2
30	63.1	252.5	568.1	1578.3	3551.2	6313.3
35	85.8	343.7	773.3	2148.2	4833.5	8593.1
40	112.1	448.9	1010.0	2805.8	6313.2	11223.6
45	141.9	568.2	1278.3	3551.1	7990.1	14204.9
50	175.2	701.5	1578.1	4384.0	9864.4	17536.9
55	212.0	848.8	1909.6	5304.7	11935.9	21219.6
60	252.3	1010.1	2272.5	6313.0	14204.7	25253.1
65	296.1	1185.5	2667.1	7409.0	16670.8	29637.3
70	343.4	1374.9	3093.2	8592.7	19334.1	34372.3
75	394.2	1578.3	3550.8	9864.1	22194.8	39458.0
80	448.5	1795.8	4040.0	11223.1	25252.8	44894.4
85	506.3	2027.3	4560.8	12669.9	28508.0	50681.6
90	567.6	2272.8	5113.2	14204.3	31960.5	56819.5

FIG. 4a

II. LIFT FORCE (LB.)

WIND SPEED	SIZE(DIAMETER OF THE BALLOON BEFORE INFLATION, FT.)					
	10	20	30	50	75	100
	ESTIMATED VOLUME CREATED AFTER INFLATION (CU. FT.)					
	189.1	1513.1	5106.6	23641.7	79790.7	189133.6
	ESTIMATED CROSS SECTION AREA AFTER INFLATION (SQ. FT.)					
	49.7	199.0	447.7	1243.7	2798.4	4975.0
10	6.1	24.5	55.1	153.0	344.2	611.9
15	13.8	55.1	123.9	344.2	774.5	1376.8
20	24.5	97.9	220.3	611.9	1376.8	2447.7
25	38.2	153.0	344.2	956.1	2151.3	3824.5
30	55.0	220.3	495.6	1376.8	3097.8	5507.3
35	74.9	299.8	674.6	1873.9	4216.5	7496.1
40	97.8	391.6	881.1	2447.6	5507.3	9790.8
45	123.8	495.7	1115.1	3097.7	6970.1	12391.5
50	152.8	611.9	1376.7	3824.4	8605.1	15298.1
55	184.9	740.4	1665.8	4627.5	10412.1	18510.7
60	220.1	881.2	1982.4	5507.1	12391.3	22029.3
65	258.3	1034.2	2326.6	6463.2	14542.6	25853.8
70	299.5	1199.4	2698.3	7495.8	16866.0	29984.3
75	343.9	1376.8	3097.5	8604.8	19361.4	34420.8
80	391.2	1566.5	3524.3	9790.4	22029.0	39163.2
85	441.7	1768.5	3978.6	11052.5	24868.7	44211.6
90	495.2	1982.6	4460.4	12391.0	27880.5	49565.9

FIG. 4b

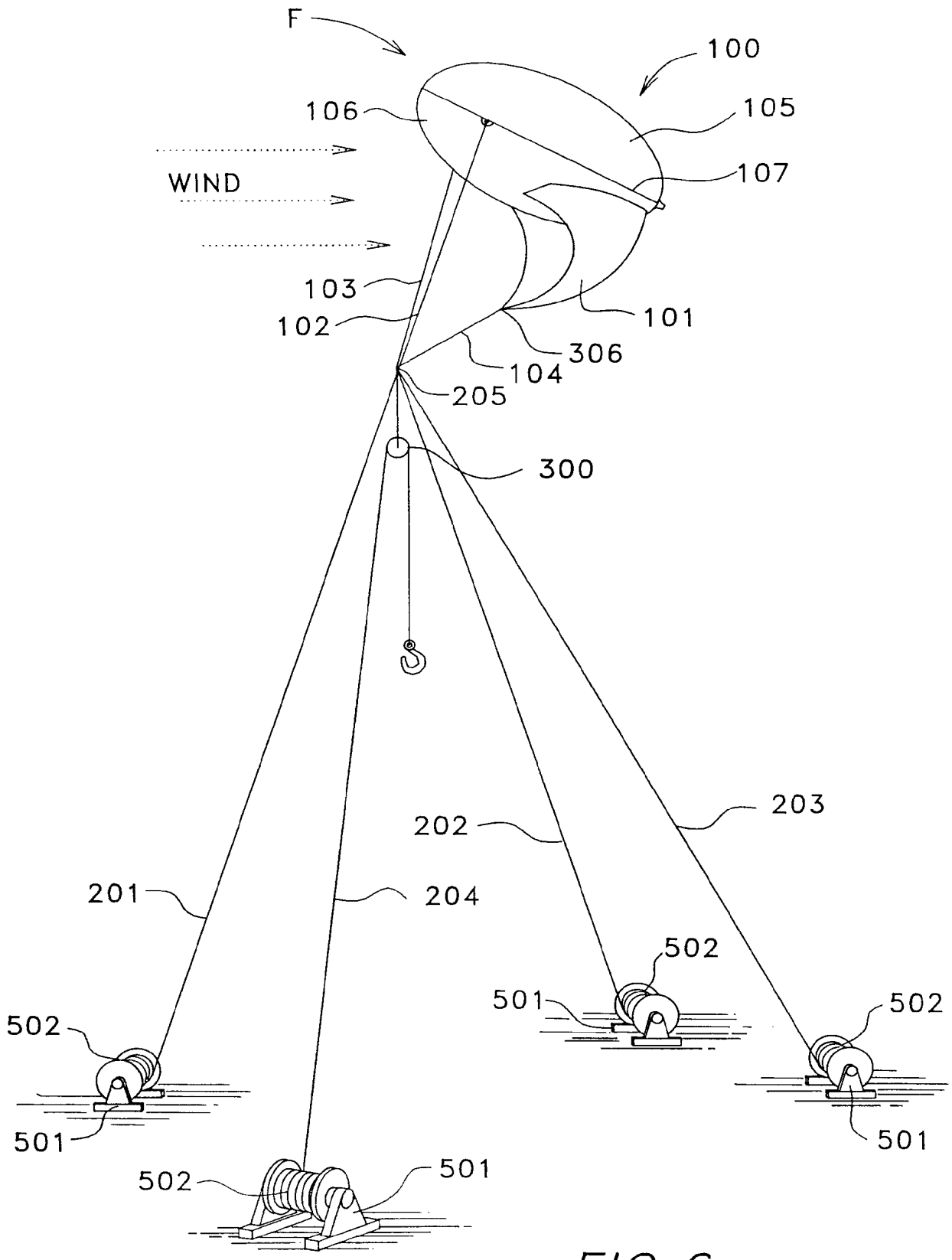
F
100
106
105
WIND
107
103
101
102
306
104
205
300
203
202
201
204
502
501
502
502
501
502
501

FIG. 6

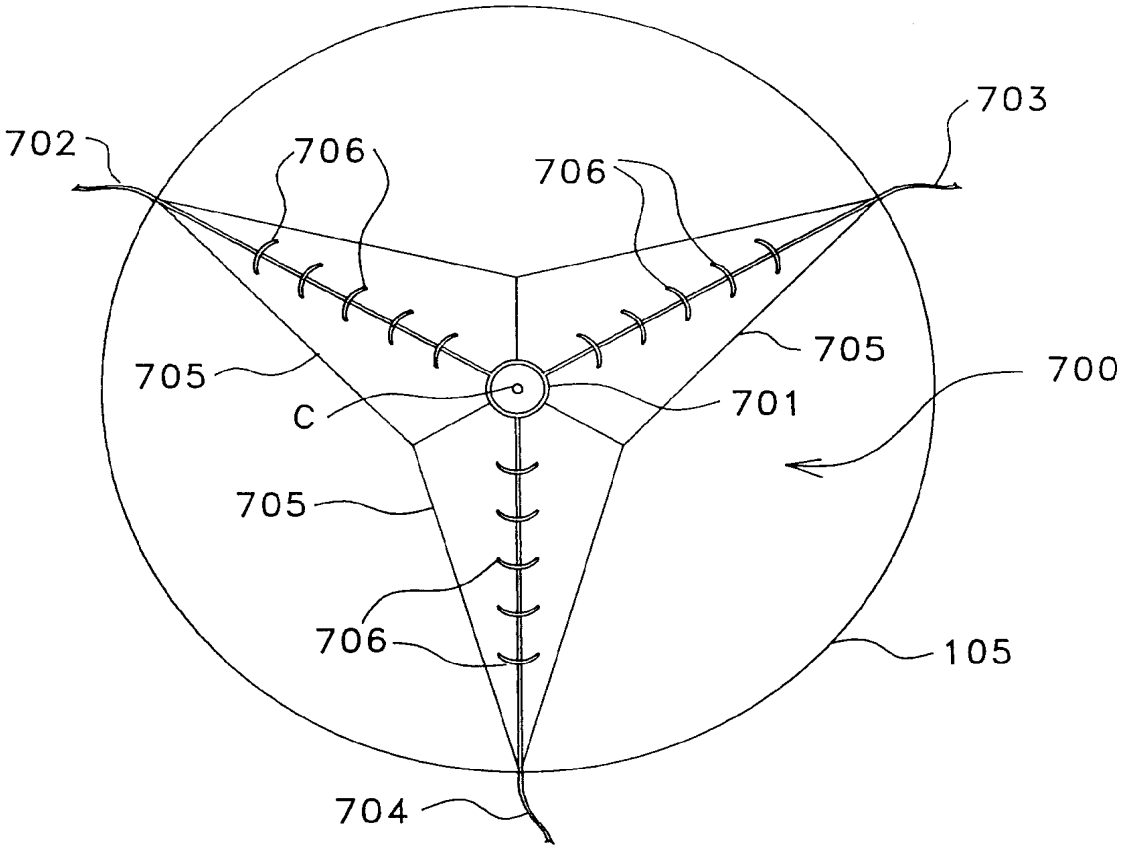
703
702
706
706
705
705
700
C
701
705
706
105
704

FIG. 7

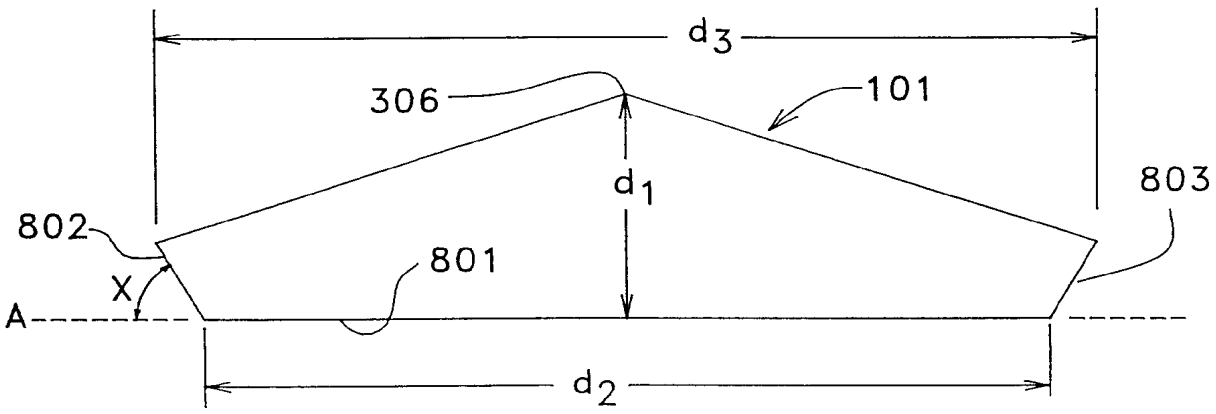
d3
306
101
d1
803
802
801
X
A
d2

FIG. 8

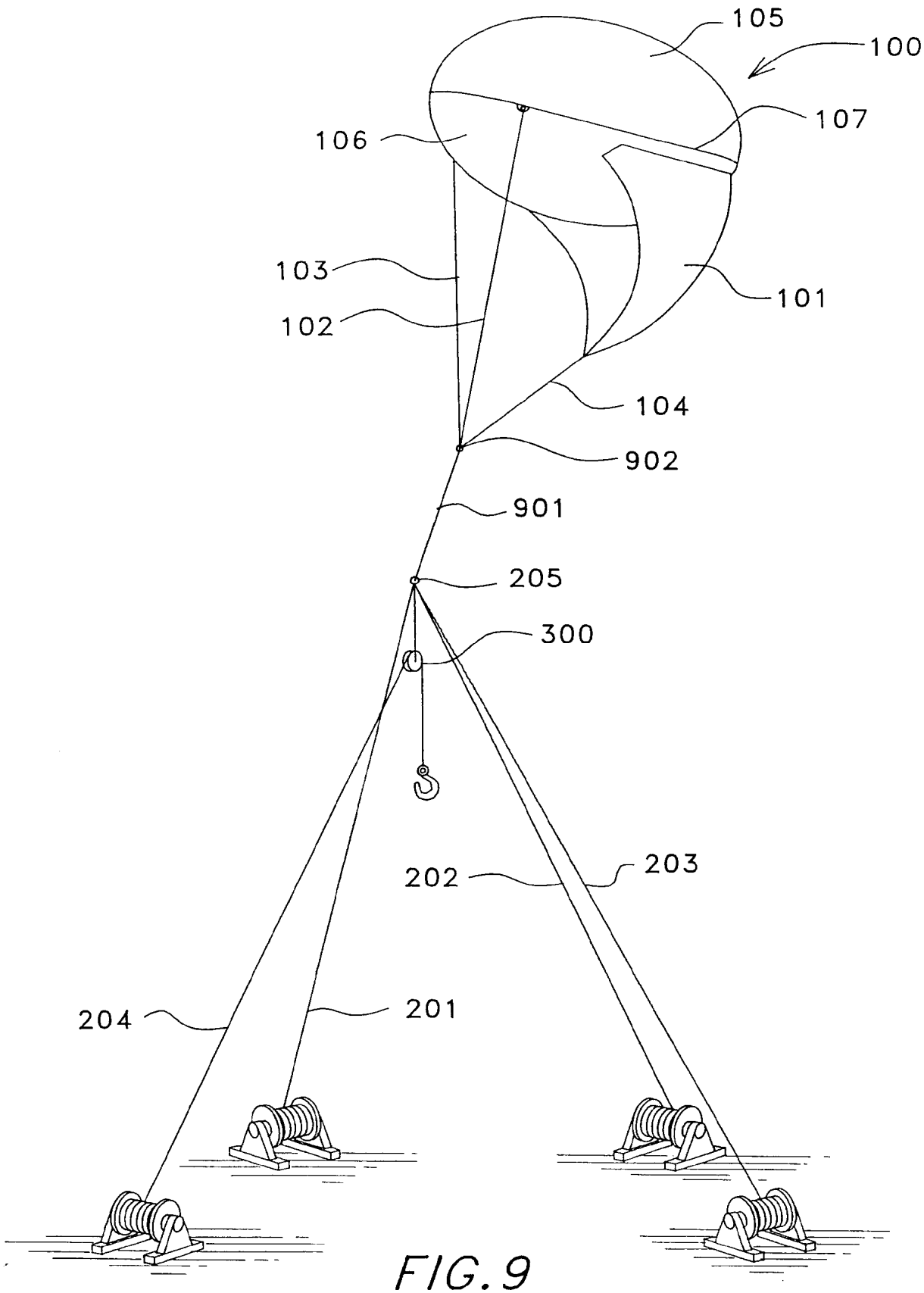

FIG. 9

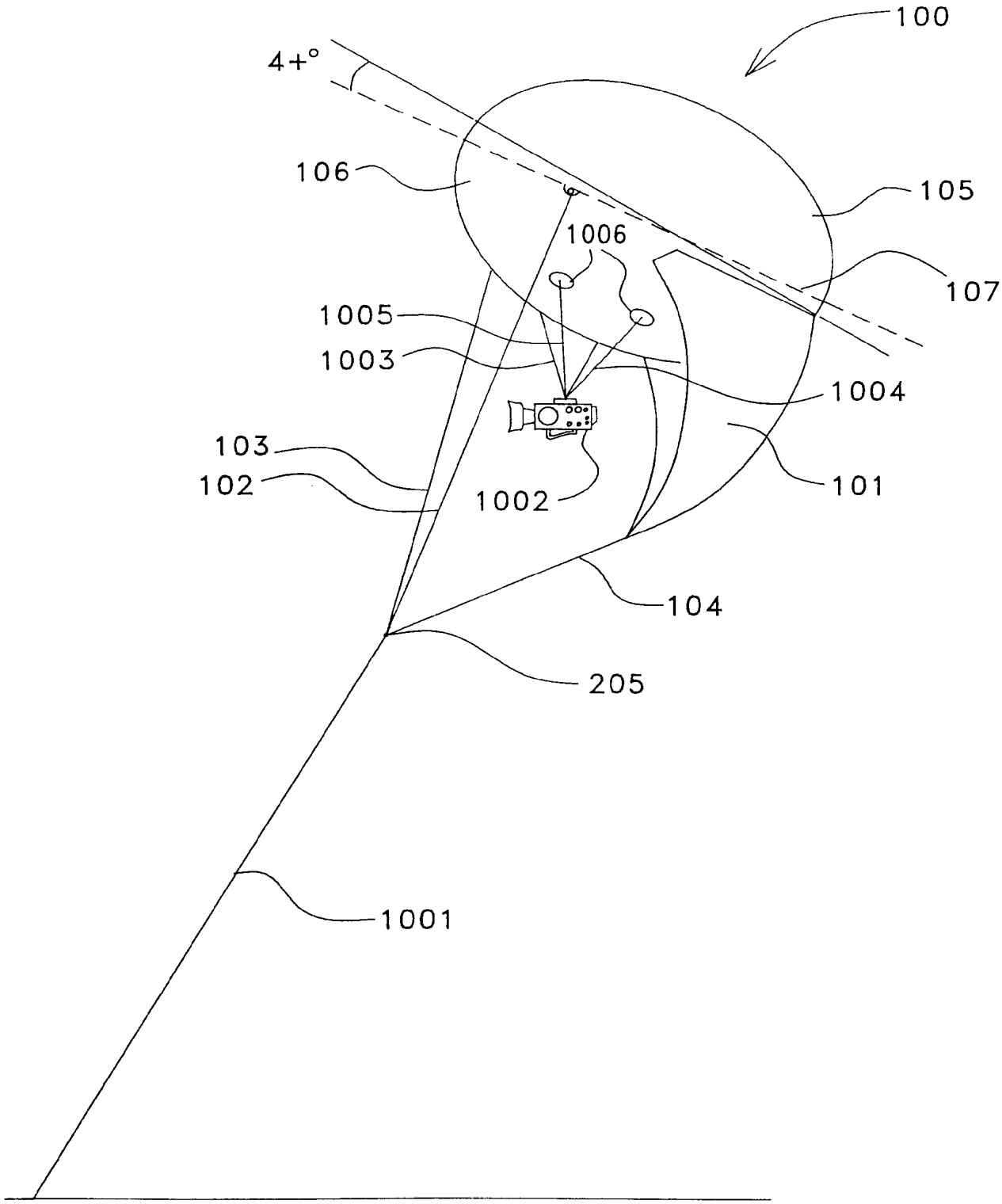
100
4+°
106
105
1006
107
1005
1003
1004
103
102
1002
101
104
205
1001

FIG. 10

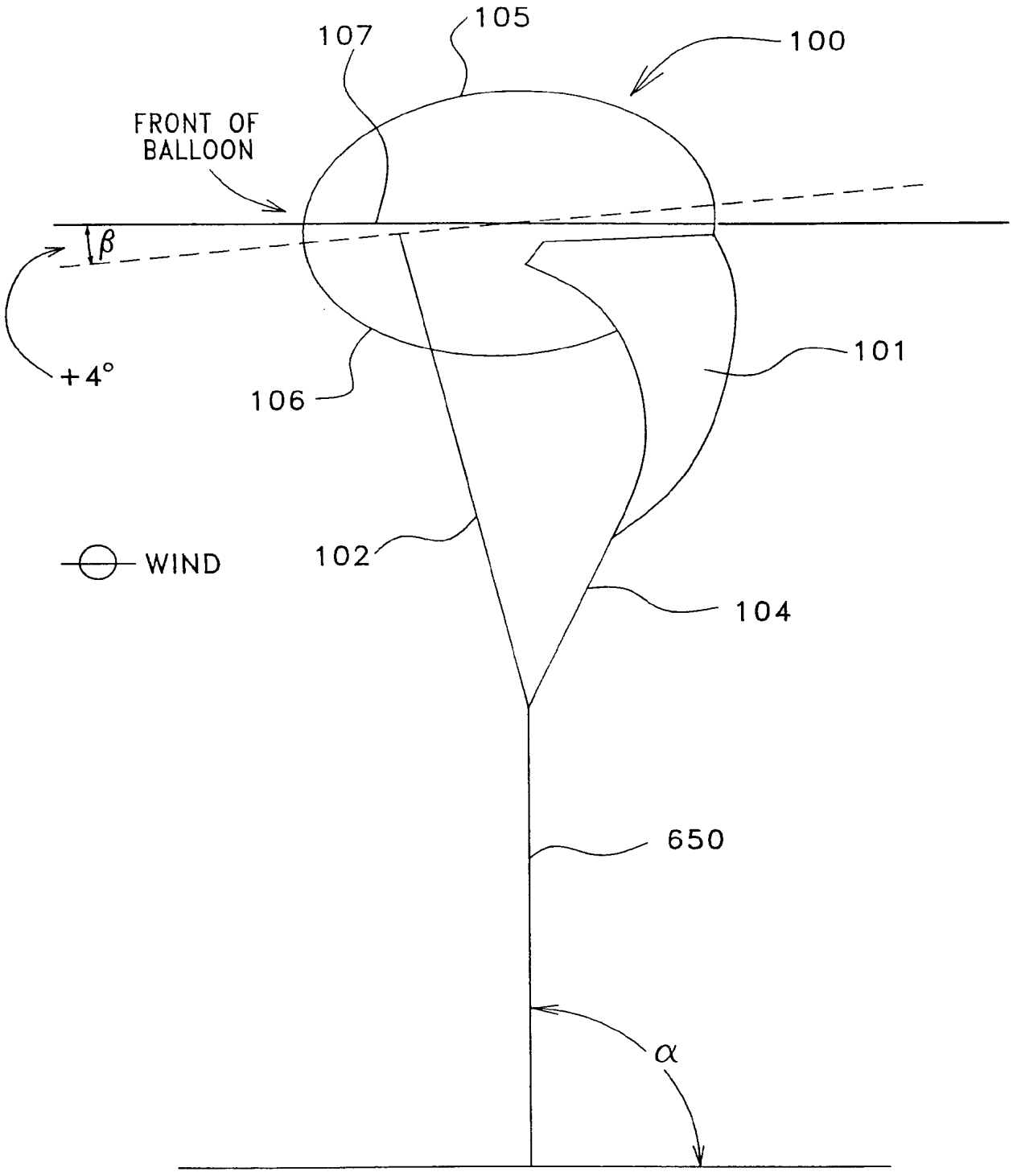

FIG. 11

INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/US 00/12305

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B64B1/42 B64B1/50 B64B1/52

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B64B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 1 686 646 A (UPSON R H) 9 October 1928 (1928-10-09)	1-5,13
A	page 2, line 12 - line 42 page 3, line 5 - line 19	9-12
X	FR 787 642 A (ZODIAC) 26 September 1935 (1935-09-26) the whole document	1-5,13
A	DE 75 731 C (RIEDINGER A, VON SIEGSFELD H) 5 October 1898 (1898-10-05) the whole document	1-5,9-13
A	GB 147 161 A (THE GOODYEAR TIRE AND RUBBER CO.) 27 October 1921 (1921-10-27) page 2, line 48 - line 60	1,2,4,5, 9,11-13

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 August 2000	30/08/2000

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/US 00/12305

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	US 3 620 486 A (ROSS ROBERT S ET AL) 16 November 1971 (1971-11-16) the whole document	1-5,9, 13-15
A	"Hoisted by skyhook" PRODUCT ENGINEERING, 12 October 1964 (1964-10-12), page 57 XP002145056 the whole document	1-5,9, 13-15

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte onal Application No
PCT/US 00/12305

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 1686646	A	09-10-1928	NONE	
FR 787642	A	26-09-1935	NONE	
DE 75731	C		NONE	
GB 147161	A		NONE	
US 3620486	A	16-11-1971	NONE	